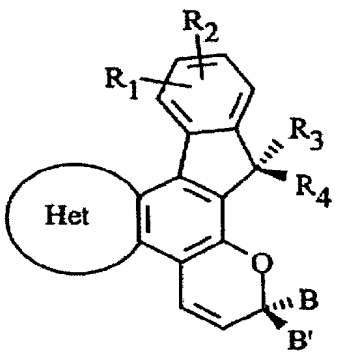
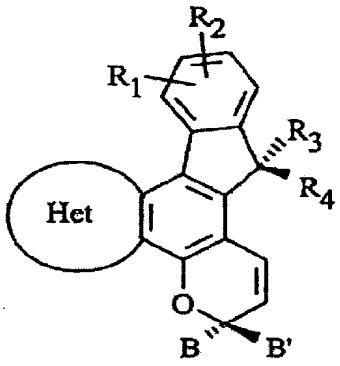
Claims

1. Photochromic indenochromenes having the general formula (I) or (II):



(I)



(II)

wherein

groups R_1 and R_2 represent, independently from each other, a substituent selected from group A, consisting of hydrogen, fluorine, chlorine, bromine, a hydroxy group, a (C_1-C_6) alkyl group, a (C_1-C_6) alkoxy group, a (C_3-C_7) cycloalkyl group which may have one or more heteroatoms, a (C_1-C_6) acyl group, an unsubstituted or monosubstituted phenyl group, and an unsubstituted or monosubstituted benzyl group, wherein their substituents are selected from the group consisting of a (C_1-C_6) alkyl group and a (C_1-C_6) alkoxy group;

or the groups R_1 and R_2 together represent an annellated, unsubstituted, monosubstituted or disubstituted benzo or pyrido ring whose substituents are selected from group A;

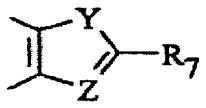
group R_3 represents a substituent selected from among hydrogen, a (C_1-C_6) alkyl group and –OM, wherein M is a substituent selected from group A;

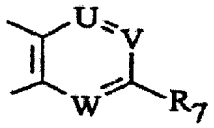
group R_4 is a substituent selected from among hydrogen, a hydroxy group, a (C_1-C_6) alkyl group, a (C_1-C_6) alkoxy group, a (C_3-C_7) cycloalkyl group, a (C_1-C_6) alkyl group, a respectively unsubstituted, mono-, di- or trisubstituted phenyl group, benzyl group, naphthyl group, phenanthryl group, pyrenyl group, quinolyl group, isoquinolyl group, benzofuranyl group, thienyl group, benzothienyl

group, dibenzofuranyl group, dibenzothienyl group, carbazolyl group or indolyl group, wherein their substituents are selected from group A, a (C_1-C_6)-ω-phenylalkyl group and a (C_1-C_6)-ω- phenoxyalkyl group, wherein the phenyl ring in ω-position in turn may be part of an additional photochromic pyran system;

or the groups R_3 and R_4, including the central spiro carbon atom together represent a saturated and/or unsaturated ring member with 5 to 8 carbon atoms, of which maximally one may be substituted by a heteroatom selected from the group consisting of O, S and NR_5, wherein group R_5 is selected from group A and wherein at least one aromatic or heteroaromatic ring system is annellated to the ring member, wherein the ring system is selected from group E consisting of benzene, naphthalene, phenanthrene, pyridine, quinoline, furan, thiophene, pyrrole, benzofuran, benzothiophene, indole and carbazole, and the ring system may have one or more substituents from group A;

the annellated heterocycle (Het) represents a 5 or 6-membered heteroaromatic ring cycle having the following formulas:





wherein Y is selected from among oxygen, sulfur and NR_5, and Z, U, V and W are selected independently from each other from among nitrogen and CR_6, wherein the groups R_6 and R_7 represent, independently from each other, a substituent of group A, or groups R_6 and R_7 if they are ortho to one another together represent an unsubstituted or monosubstituted benzene ring whose substituents are selected from group A; and

B and B' independently from each other are selected from one of the following groups a), b), c) or d), wherein

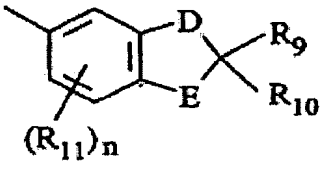
a) they are mono-, di- and trisubstituted aryl groups, wherein the aryl group is phenyl or naphthyl;

b) they are unsubstituted, monosubstituted and disubstituted heteroaryl groups, wherein the heteroaryl group is pyridyl, furanyl, benzofuran-2-yl, benzofuran-3-yl, thien-2-yl,

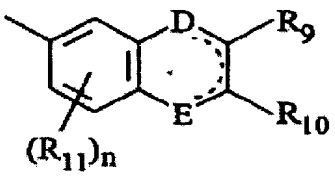
thien-3-yl, benzothien-2-yl, benzothien-3-yl, phenazinyl, phenoxazinyl, phenothiazinyl or julolidinyl;

wherein the substituents of the aryl or heteroaryl groups in a) and b) are those selected from the group consisting of the above-defined group A, hydroxy, amino, mono-(C_1-C_6) alkylamino, di-(C_1-C_6) alkylamino, mono- and diphenylamino unsubstituted, monosubstituted or disubstituted on the aromatic, wherein their substituents in turn are selected from group A, pyrrolidinyl, piperidinyl, morpholinyl, thiomorpholinyl, phenazinyl, phenoxazinyl, phenothiazinyl, carbazolyl, unsubstituted, monosubstituted and disubstituted pyrryl, wherein its substituents are selected from group A,

c) structural units with the following structural formulas (B) and (C):



(B)



(C)

wherein

D and E independently from each other represent oxygen, sulfur, carbon or NR_8, wherein the groups R_8, R_9, R_{10} and R_{11} independently from each other represent a substituent from group A, wherein n is 1, 2, or 3, provided that if D represents NR_8 in formula (B), E represents carbon,

or

d) B and B' together form an unsubstituted, monosubstituted or disubstituted fluorene-9-ylidene group or a saturated hydrocarbon group, which is C_3-C_{12} spiro monocyclic, C_7-C_{12} spiro bicyclic and/or C_7-C_{12} spiro tricyclic, wherein the fluorene substituents are selected from group A.

2. Photochromic indenochromenes as claimed in Claim 1, wherein the annellated heterocycle (Het) is an indole unit, a benzofuryl unit, a benzothienyl, a thienyl unit, a furyl unit, an oxazolyl unit, an imidazolyl unit, a pyrimidinyl unit, a pyrazinyl unit or a triazinyl unit.

3. Photochromic indenochromenes as claimed in Claim 1 or 2, wherein B and B'

independently from each other represent mono-, di- or trisubstituted phenyl groups, wherein the substituents are those selected from the group consisting of the above-defined group A, hydroxy, amino, mono-(C_1-C_6) alkylamino, di-(C_1-C_6) alkylamino, mono- and diphenylamino unsubstituted, monosubstituted or disubstituted on the aromatic, wherein their substituents in turn are selected from group A, pyrrolidinyl, piperidinyl, morpholinyl, thiomorpholinyl, phenazinyl, phenoxazinyl, phenothiazinyl, carbazolyl, unsubstituted, monosubstituted and disubstituted pyrryl, wherein its substituents are selected from group A.

4. Photochromic indenochromenes as claimed in Claim 1 or 2, wherein B and B' independently from each other represent a julolidinyl group.

5. Photochromic indenochromenes as claimed in any one of the preceding claims, which are

2-(2-fluorophenyl)-2-phenyl-2,14-dihydro-[1]benzofuro[2,3-f]indeno[1,2-h] chromene,

2-(2-fluorophenyl)-2-(4-methoxyphenyl)-2,14-dihydro-[1]benzofuro[2,3-f]indeno-[1,2-h] chromene,

2-(2-flurophenyl)-2-(4-(4-morpholinyl)phenyl)-2,14-dihydro-[1]benzofuro[2,3-f]-indeno-[1,2-h] chromene,

2-(2-fluorophenyl)-2-phenyl-2,14-dihydro-[1]benzothieno[3,2-f]indeno[1,2-h] chromene,

2-(2,4-dimethylphenyl)-2-phenyl-2,14-dihydro-[1]benzothieno[3,2-f]indeno-[1,2-h] chromene,

2-(2-fluorophenyl)-2-(4-methoxyphenyl)-2,14-dihydro-[1]benzothieno[3,2-f]indeno[1,2-h] chromene

2-(2-fluorophenyl)-2-phenyl-2,12-dihydroindeno[1,2-h]thieno[2,3-f] chromene

2-(2-fluoro-phenyl)-2-phenyl-9-methyl-2,9-dihydro-14H-indeno[1,2-h]indolo-[3,2-f] chromene and

spiro-9-fluorene-12'-[3,3-diphenyl-3,12-dihydroindeno[2,1-f]-thieno[2,3-h] chromene.

6. Use of the photochromic indenochromenes as claimed in any one of Claims 1 to 5 in plastic materials.

7. Use as claimed in Claim 6, wherein the plastic material is an ophthalmic lens.